METHOD AND DEVICE FOR PROCESSING COLOR PICTURE

Patent Number: JP7087347
Publication date: 1995-03-31
Inventor(s): KITA SHINJI; others: 02
Applicant(s):: FUJI XEROX CO LTD
Requested Patent: JP7087347
Application Number: JP19930248476 19930910
Priority Number(s):
IPC Classification: H04N1/60 ; G06T1/00 ; H04N1/46
EC Classification:
Equivalents:

OIPE JC68
JUL 11 2001
PATENT TRADEMARK OFFICE

Abstract

PURPOSE:To provide a color conversion processing method/device by which plural different input chrominance signals can be processed irrespective of the kind and faithfully be reproduced.
CONSTITUTION:First conversion means 1-4 convert the plural different input chrominance signals outputted from a color picture input device and a color picture generation device into three variable chrominance signals on perceptively equivalent uniform chrominance spaces. A second conversion means 7 converts the three variable chrominance signals into a picture recording signals of four colors including Chinese ink. The first conversion means are provided with an input judgement means 1 judging a signal Dfig showing the types of the input chrominance signals, a weight memory 3 storing conversion information weight coefficients, which are previously defined for respective kinds of the chrominance signals, and a non-linear conversion circuit 4 deciding a conversion characteristic based on conversion information corresponding to the kinds of the chrominance signals in accordance with the result of input judgement and it is provided with a learning means so that it can deal with the new chrominance signal which is not defined.

Data supplied from the esp@cenet database - I2

RECEIVED
JUL 12 2001
TC 2600 MAILROOM

01- 2-27: 5:43PM:NGB PATENT DEPT MORGAN, LEWIS :8135561395 6 # 2/ 2

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 07-087347

(43)Date of publication of application : 31.03.1995

(51)Int.Cl. H04N 1/60
G06T 1/00
H04N 1/46

(21)Application number : 05-248476

(22)Date of filing : 10.09.1993

(71)Applicant : FUJI XEROX CO LTD

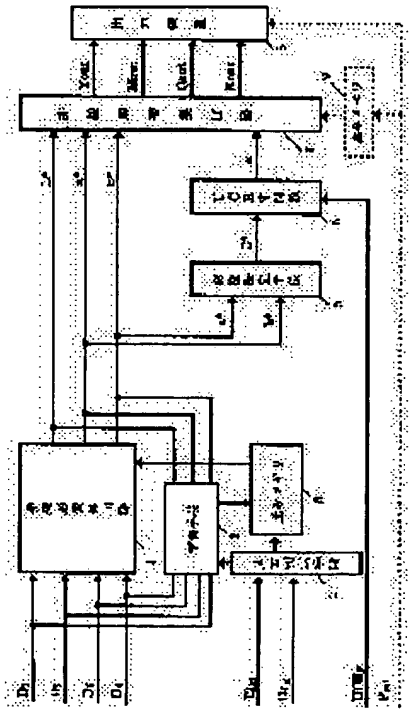
(72)Inventor : KITA SHINJI
KOKATSU HITOSHI
MURAI KAZUMASA

(54) METHOD AND DEVICE FOR PROCESSING COLOR PICTURE

(57)Abstract:

PURPOSE: To provide a color conversion processing method/device by which plural different input chrominance signals can be processed irrespective of the kind and faithfully be reproduced.

CONSTITUTION: First conversion means 1-4 convert the plural different input chrominance signals outputted from a color picture input device and a color picture generation device into three variable chrominance signals on perceptively equivalent uniform chrominance spaces. A second conversion means 7 converts the three variable chrominance signals into a picture recording signals of four colors including Chinese ink. The first conversion means are provided with an input judgement means 1 judging a signal Dflg showing the types of the input chrominance signals, a weight memory 3 storing conversion information weight coefficients, which are previously defined for respective kinds of the chrominance signals, and a non-linear conversion circuit 4 deciding a conversion characteristic based on conversion information corresponding to the kinds of the chrominance signals in accordance with the result of input judgement and it is provided with a learning means so that it can deal with the new chrominance signal which is not defined.



h g e e h

LEGAL STATUS

[Date of request for examination]	12.09.1996
[Date of sending the examiner's decision of rejection]	15.03.2000
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3488729
[Date of registration]	31.10.2003
[Number of appeal against examiner's decision of rejection]	2000-05221
[Date of requesting appeal against examiner's decision of rejection]	13.04.2000
[Date of extinction of right]	

Copyright (C); 1998,2003 Japan Patent Office

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 07-087347

(43)Date of publication of application : 31.03.1995

(51)Int.Cl. H04N 1/60
G06T 1/00
H04N 1/46

(21)Application number : 05-248476

(22)Date of filing : 10.09.1993

(71)Applicant : FUJI XEROX CO LTD

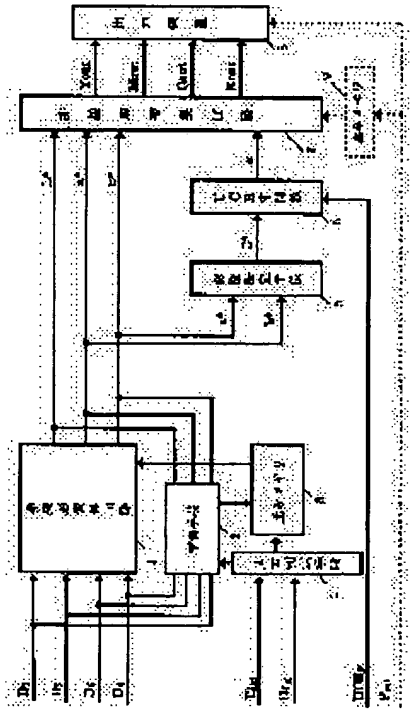
(72)Inventor : KITA SHINJI
KOKATSU HITOSHI
MURAI KAZUMASA

(54) METHOD AND DEVICE FOR PROCESSING COLOR PICTURE

(57)Abstract:

PURPOSE: To provide a color conversion processing method/device by which plural different input chrominance signals can be processed irrespective of the kind and faithfully be reproduced.

CONSTITUTION: First conversion means 1-4 convert the plural different input chrominance signals outputted from a color picture input device and a color picture generation device into three variable chrominance signals on perceptively equivalent uniform chrominance spaces. A second conversion means 7 converts the three variable chrominance signals into a picture recording signals of four colors including Chinese ink. The first conversion means are provided with an input judgement means 1 judging a signal Dflg showing the types of the input chrominance signals, a weight memory 3 storing conversion information weight coefficients, which are previously defined for respective kinds of the chrominance signals, and a non-linear conversion circuit 4 deciding a conversion characteristic based on conversion information corresponding to the kinds of the chrominance signals in accordance with the result of input judgement and it is provided with a learning means so that it can deal with the new chrominance signal which is not defined.



LEGAL STATUS

[Date of request for examination]	12.09.1996
[Date of sending the examiner's decision of rejection]	15.03.2000
[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]	
[Date of final disposal for application]	
[Patent number]	3488729
[Date of registration]	31.10.2003
[Number of appeal against examiner's decision of rejection]	2000-05221
[Date of requesting appeal against examiner's decision of rejection]	13.04.2000
[Date of extinction of right]	

Copyright (C); 1998,2003 Japan Patent Office

* NOTICES *

Japan Patent Office is not responsible for any damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the color picture art and equipment for obtaining a desired printed output from various chrominance signals especially about the color picture art and equipment which change into the image recording signal of four colors containing Japanese ink three chrominance signals outputted from a color picture input unit / color picture listing device.
[0002]
[Description of the Prior Art] Color transform processing, such as the conventional color printer/color copying machine, limits an input color, and performs color transform processing doubled with the color reproduction property of the target recording device. For example, in a color copying machine, since the input section is built in in equipment, for a specific manuscript color, a printed output is carried out from an input, and color transform processing from an input chrominance signal to a record chrominance signal is performed so that a printed output and a manuscript color may be in agreement. Moreover, in a color printer, beforehand, an input chrominance signal is limited to a certain representation signal, and color transform processing to a record chrominance signal is set up supposing the input chrominance signal being inputted. It is NTSC generally used on television. An RGB code is the representation input signal, and color coincidence of a display and a printed output is NTSC. Transform processing from an RGB code to record chrominance-signal cyanogen, a magenta, yellow, and black is set up.
[0003] However, current various color I/O media were diversified, moreover, inter exchange came to be carried out through the network, and the color signal is also diversified increasingly. For example, the condition has appeared in the format of typical application software of editing color picture information. The color expression specification of typical application software is shown in drawing 2 . As a color space, all of HSL defined by the deformation operation from (1) RGB space and (2) RGB space, HSB space, and the CMYK space using (3) record colors itself are usable. Generally, with a utilization gestalt which makes a printout the final output, a CMYK signal is used and it is transmitted to the platemaking scanner of printing.
[0004] Moreover, even when the above-mentioned color space is the same, the case where actual color data differ is also known well. For example, an RGB code is also NTSC. The RGB code differed from the RGB code of a common color scanner, and the difference has produced it by the difference in an optical response etc. that much also among two or more sorts of color scanners. Even if it uses the same CMYK signal by similarly different color-material set also in CMYK space, print colors differ. That is, apart from a color space, the index whether a color signal is dependent on a device exists. A device independent signal points out a convertible signal to colorimetry color coordinate space (CIE XYZ, L*a*b*, L*u*v*, etc.) using a well-known definition type, and is NTSC. An RGB code hits this. on the contrary, device DEPEN -- a dent signal is a signal set up supposing many properties of a certain specific device, and a CMYK signal, the RGB code in a color scanner, etc. hit this. device DEPEN -- the case where a dent signal is processed with other devices -- a certain form -- device DEPEN -- the response relation between a dent signal and a device independent signal must be described. This

response is color matching of drawing 2 , and the color coordinate value to two or more CMYK signals is given. Two or more these exist like drawing 2 corresponding to the class of printing ink etc.
[0005]
[Problem(s) to be Solved by the Invention] As mentioned above, color transform processing for not depending many input chrominance signals on the class, but reappearing that it can process and faithfully moreover does not exist till now. But a method realizable in approximation is a method which prepares two or more the transform coefficients in the input color which is different from each other using well-known matrix type color transform processing, and changes and uses a multiplier according to the class of input color. However, according to this method, it is known that sufficient color reproducibility will not be obtained from the nonlinear characteristic of a storage device. Moreover, in 4 inputs, an input signal cannot extend conversion simply like a CMYK signal. As color transform processing for reappearing more faithfully, although a direct look-up table type color conversion method is learned, when adapted for many input chrominance signals in this method, it is necessary to store an input color by the class, and memory cost increases a translation table. Moreover, like the above-mentioned matrix mold, like a CMYK signal in an input signal, memory magnitude and interpolation operation magnitude cannot become large, and, in 4 inputs, conversion cannot be extended simply.
[0006] This invention aims at offering the color transform-processing approach and equipment for not depending two or more input chrominance signals on the class, but reappearing that it can process and faithfully moreover in view of the fault of the above mentioned conventional technique. It can respond not only to the chrominance signal of 3 inputs especially represented by an RGB code or the deformation signal of an RGB code but to four input signals like a CMYK signal, and aims at offering the color transform-processing approach and equipment which can moreover do a rendering faithfully.
[0007] Moreover, even if this invention sets up the rate of UCR highly, it is enabling it to perform exact color reproduction, and it sets it as the object to offer the color picture processor which performs improvement in the gray balance in a photograph, and improvement in black alphabetic character quality.
[0008] Furthermore, this invention is a device independent signal. (colorimetry color coordinate space) Based on the color matching data with which a response is attached also to an undefined input chrominance signal, response relation is learned and it sets it as the object to offer the color picture processor which generates a color transform coefficient in self-multiplication.
[0009] Furthermore, this invention sets it as the object to offer the high-speed small color picture processor of circuit magnitude, satisfying the above-mentioned object by performing the operation of a part or the whole by two or more association of a nonlinear arithmetic unit.
[0010]
[Means for Solving the Problem] the color picture art of this invention (claim 1) -- plurality -- difference -- the perception from a chrominance signal ---like -- etc. -- the 2nd conversion step changed into the image recording signal of four colors containing Japanese ink from the 1st conversion step changed into 3 variable chrominance signal on the uniform color space like a step, and 3 variable chrominance signal on uniform color space -- having -- **** -- plurality -- difference -- conversion to the image recording signal of four colors from a chrominance signal is performed.
[0011] according to one mode (claim 2) of this invention -- the 1st conversion step -- plurality -- difference -- about what relation with uniform color space is defined among chrominance signals, it has the transform coefficient beforehand, and about an undefined thing, a transform coefficient is learned based on two or more sets of educator data, and it is constituted so that it may increase serially. According to other modes (claim 3) of this invention, the 2nd conversion step determines the rate of UCR (Under Color Removal) from the saturation signal on uniform color space, and determines the image recording signal of the rate of UCR, and four colors which contained Japanese ink from 3 variable chrominance signal on uniform color space. According to other modes (claim 4) of this invention, the operation of a part or the whole is performed by two or more association of a nonlinear arithmetic unit.
[0012] color picture processing (claim 5) of this invention for enforcing the above-mentioned approach -- plurality -- difference -- the perception from a chrominance signal ---like -- etc. -- it has the 2nd

conversion means (7 of drawing 1) changed into the image recording signal of four colors containing Japanese ink from the 1st conversion means (1-4 of drawing 1) changed into 3 variable chrominance signal on the uniform color space like a step, and 3 variable chrominance signal on uniform color space as a basic configuration.

[0013] The chrominance signal with which, as for said 1st conversion means, plurality is different from each other according to one mode (claim 6) of this invention, A storage means to memorize the transfer characteristic information which defines relation with uniform color space, respectively (3 of drawing 1), plurality -- difference -- it has an input judging means (1 of drawing 1) to judge whether which data of a chrominance signal are inputted, and a nonlinear conversion means (4 of drawing 1) by which the transfer characteristic is set up by loading the transfer characteristic information corresponding to the judgment of the input judging means from said storage means.

[0014] Furthermore, in one mode (claim 7) of this invention, when the relation between a chrominance signal and uniform color space is the thing of the undefined, a nonlinear conversion means is made to learn with an educator signal, and a study means (2 of drawing 1) to make said storage means memorize the transfer characteristic information acquired as a result of study is established.

[0015] According to the mode (claim 8) of everything [means / 2nd / nonlinear conversion means / in said 1st conversion means /, or / both / both / either or / conversion] but this invention, the network circuit (drawing 8 , drawing 9) which comes to join two or more nonlinear arithmetic units of each other together is used.

[0016] Said nonlinear arithmetic unit used for said network circuit A nonlinear function operation means according to other modes (claim 9) of this invention to have two or more inputs and to perform a nonlinear function operation to each of that input (51a-51n of drawing 5), The multiplication means which multiplies by the weight value which corresponds, respectively to each function value obtained as a result of the operation of those nonlinear function operation means (52a-52n of drawing 5), It asked for the sum of each result obtained by that each means of multiplication, and has an addition means (53 of drawing 5) to add a threshold further. Although any of a digital circuit and an analog circuit may realize, if an analog circuit like the next constitutes a nonlinear arithmetic unit, it has the advantage of the simplification of a circuit, and improvement in the speed.

[0017] An analog circuit constitutes the association of said nonlinear function operation means and said multiplication means. Namely, an example (claim 10) of the configuration of the analog circuit 1 It consists of a differential amplifying circuit which combined mutually each 1st terminal of a pair of 3 terminal amplifier (drawing 6 Q1 and Q2). An output is obtained as a difference of the current between each 2nd terminal of 3 terminal amplifier which constitutes said differential amplifying circuit by supplying the electrical-potential-difference difference proportional to said input between each 2nd terminal of said 1 to 3 terminal amplifier, and supplying the current which is proportional to said 1st terminal at a weight value.

[0018] The analog circuit combines respectively the 1st terminal of 1st and 2nd 3 terminal amplifier, and other examples (claim 11) constitute the 1st differential amplifying circuit (element -1 of drawing 7). Combine respectively the 1st terminal of 3rd and 4th 3 terminal amplifier, and the 2nd differential amplifying circuit (element -2 of drawing 7) is constituted. Combine each 2nd terminal of 1st and 4th 3 terminal amplifier, and it considers as the 1st input terminal. Combine each 2nd terminal of 2nd and 3rd 3 terminal amplifier, and it considers as the 2nd input terminal. The electrical potential difference proportional to an input is supplied between the 1st input terminal and the 2nd input terminal. Connect the 3rd terminal of 3rd 3 terminal amplifier with the 1st, and it considers as the 1st output terminal. By connecting the 3rd terminal of 4th 3 terminal amplifier with the 2nd, considering as the 2nd output terminal, and supplying a current with the current difference proportional to a weight value to the 1st terminal of the 1st and the 2nd differential amplifying circuit a function monotonous to an input on an owner community -- giving -- positive/negative -- the output current difference proportional to multiplication with which value is acquired to the 1st and the 2nd output terminal.

[0019] moreover, this invention (claim 13) -- plurality -- difference -- the perception from a chrominance signal ---like -- etc. -- with the 1st conversion means (1-4 of drawing 1) changed into 3

variable chrominance signal on the uniform color space like a step A saturation decision means to search for the saturation signal on uniform color space based on the conversion output of said 1st conversion means (5 of drawing 1), It has the 2nd conversion means (7 of drawing 1) changed into the image output signal of four colors containing Japanese ink from said 3 variable chrominance signal on a rate decision means of UCR (6 of drawing 1) to determine the rate of UCR from the saturation signal acquired by the saturation decision means, and said rate of UCR and uniform color space.
[0020] According to one mode (claim 14) of this invention, said rate decision means of UCR has an adjustment parameter (C*1, Ak1), an adjustment parameter input means to input (C*2, Ak2), and an operation means to ask for the rate of UCR with the function of a degree type. A polygonal-line mold function as shown below as the function, and the continuous function of monotone and a saturation mold can be used.
(a) At the time of polygonal-line mold function C*<C*1 At the time of alpha=Ak 1C*1 <=C*<C*2 At the time of alpha=(C*-C*1)/(C*2-C*1) x(Ak2-Ak1)+Ak1C*2 <=C* alpha=Ak 2 (b) Continuous function of monotone and a saturation mold alpha=Ak2+(Ak1-Ak2) x [1-tanh (pi/2x(C*-a)/b)]/2 -- here a= (C*1+C*2) / 2b=(C*2-C*1) /2alpha> It is alpha= 0 [0021] at the time of alpha=1alpha<0 at the time of 1. according to one mode (claim 16) of this invention -- 3 variable chrominance signal of uniform color space, and plurality -- difference -- the transfer characteristic of said 2nd conversion means is set up by adding a storage means to memorize two or more transfer characteristic information over an output unit that relation with the image recording signal of four colors containing Japanese ink is defined, respectively, and loading one transfer characteristic information from said storage means according to assignment of an output unit.
[0022]
[Function] In this invention, the input chrominance signal with which the plurality outputted from a color picture input unit, a color picture listing device, etc. by the 1st conversion means is different from each other is changed into 3 variable chrominance signal on the uniform color space [target / perception] like a step. 3 variable chrominance signal on ****-uniform color space is 1976. CIE A L*a*b* signal etc. is equivalent to this, by performing conversion (color correction, ******, lower color clearance) to the record signal later mentioned based on this signal, the processing which suited human being's sensation is possible, and a processing configuration can be generalized in the form for which it moreover does not depend on the property of a picture input device. In order to enable it to cope with the chrominance signal (to refer to drawing 2) of the color space of the input of two or more classes, for every class of the input, this invention defines conversion relation beforehand and the defined conversion information is held for the storage means 3 by it. On the occasion of conversion, the class of input is distinguished with an input judging means, the conversion information corresponding to the distinguished class is read from a storage means, and it is set as a nonlinear conversion means. About the undefined input chrominance signal, a transform coefficient is self--study-generated automatically based on two or more sets of associated data inputted in advance of an input chrominance signal, and it increases serially. Thus, it not only can deal with two or more kinds of input chrominance signals planned beforehand, but by constituting, the color transform-processing approach and equipment of this invention can respond in interconnect with the new color picture device generated in the future. If the 2nd conversion means is changed into the image recording signal of four colors containing Japanese ink from 3 variable chrominance signal on uniform color space, no matter what thing it may use, although obtained, also in accordance with further advantage which is described below, it can have an above-mentioned advantage by considering as the configuration of 4 input 4 output which applied the input of conversion of the rate of UCR obtained based on a saturation signal.
[0023] That is, with the 2nd conversion means, with a saturation decision means, according to a definition type, saturation signal C* (for example, in the case of a L*a*b* signal, it defines as C*= (a*2+b*2) 1/2) is generated from a chromaticity signal, and the rate of UCR is determined through the function beforehand set up possible [adjustment] by the rate decision means of UCR. Since it will be easy to generate a dry area in an image if Japanese ink generally goes into the medium saturation field in which memory colors, such as green [of flesh color and grass] and empty blue, are located, the rate of

UCR in this color field should be restricted to 0. Moreover, in order to prevent that gray colors with the instability of a recording device, gray needs to be reproduced in Japanese ink Isshiki, and as for the rate of UCR, considering as 100% is desirable. Therefore, generally the rate of UCR is set as monotonous reduction to saturation.

[0024] Moreover, it is necessary to change the rate of UCR also according to the class of input image. For example, an input image can raise texture by setting up many rates of UCR to the whole of a still life in the case of a minute image. On the other hand, in the case of the image centering on a person, it becomes important like a portrait reappearing [which lessens and presses down a dry area] the rate of UCR. Therefore, the decision function of the rate of UCR is not set up uniformly, and it is necessary to make adjustment possible. Under the present circumstances, an adjustment parameter is restricted so that it can adjust simple.

[0025] Next, in the 2nd converter, four colors, cyanogen, a magenta, yellow, and the image output signal of black are determined from the rate of UCR, and a standard chrominance signal (for example, CIE L*a*b* signal). This operation turns into an operation in 4 input -4 output, and 4 color output signal is determined as a meaning. The output signal of four colors which contain Japanese ink to an input color becomes what satisfies a colorimetry faithful rendering by this, and after determining 3 color output signal, the fault that a faithful rendering will collapse by the allocation like the conventional approach of performing ****** and lower color clearance, and equipment is removed. Moreover, with this approach and equipment, even if an operation is possible to juxtaposition in 4 color output signal and it is the tandem system (announced by the ink jet and the electrophotography recording method now) with which a recording apparatus side records four chrominance signals on juxtaposition, it is applicable.

[0026] Since color transform processing corresponding to the input chrominance signal with which plurality is different from each other becomes possible and the response with color system of coordinates is especially constituted from this invention by self-study possible [a response] also to the undefined input chrominance signal in short above, interconnect with the various color picture devices put in practical use in a rear spring supporter and a broad technical field current and in the future is attained, and color reproduction of the request which various color picture devices require can be realized. Moreover, in this invention, in order to perform UCR adjustment also in consideration of the improvement in image quality in consideration of the property of a recording device (the improvement in texture, gray rendering stabilization, granular feeling reduction of a memory color, etc.), it not only guarantees the fidelity of color reproduction, but it demonstrates the effectiveness which raises the quality of an output image itself. Moreover, by making 3 variable chrominance signal on the uniform color space [target / perception] like a step intervene A series of the processings of all are constituted by device independent. Since the basis of a rate brightness [target / which matched human being's sensibility / perception] and chromaticity separation signal performs, required adjustment is realized applicable in the form which was well in agreement with human being's sensibility, without depending for this invention on the image recording approach and equipment.

[0027]

[Example] Hereafter, based on an example, the description of this invention is explained concretely, referring to a drawing. Drawing 1 shows an example of the color picture processor for carrying out this invention. An input picture signal assumes a color workstation as shown in drawing 2 , and the application of a personal computer. Then an input signal The color picture signal to four inputs (D1-D4), It consists of reference data (Tdat) in which the class (Dflg) of color data and the response relation between a device and an independent signal are shown. In advance of the color picture signal (D1-D4) to four inputs, the reference data (Tdat) in which the class (Dflg) of color data and the response relation between a device and an independent signal are shown are inputted into the input judging means 1 of this invention. The input judging means 1 sets the content of the weight memory 3 which makes the address the agreeing number to the nonlinear conversion circuit 4, when the class (Dflg) of color data is collated with the input signal list set up beforehand and the agreeing number finds it. The weight is set to the nonlinear conversion circuit 4 at the same time it inputs reference data (Tdat) into the study circuit 2, it learns the weighting factor for the nonlinear conversion mentioned later and it newly registers the

class (Dflg) of color data, and a weighting factor into the weight memory 3, when the agreeing number is not found.
[0028] The nonlinear conversion circuit 4 changes the color picture signal (D1-D4) to four inputs into rate brightness [target / perception] and chromaticity separation signal. Specifically, it is 1976. CIE A L*a*b* signal is equivalent to this and a L*a*b* signal is used as an output signal of the nonlinear conversion circuit 4 in this example. It is an operation based on [{a*, b*} signal is inputted into the saturation decision means 5 among {L*, a*, b*} signals outputted from the nonlinear conversion circuit 4, and] a definition type. C*=(a*2+b*2) 1/2 (1)
It is alike and saturation signal C* is outputted more.
[0029] Saturation signal C* is inputted into the rate function operation means 6 of UCR, and the rate alpha of UCR is determined by the operation with the parameter group supplied from the outside. The configuration of a parameter group is shown in drawing 3 . A parameter is given in C*-alpha system of coordinates by two points, (C*1, Ak1), and (C*2, Ak2). Generally it is Ak1>Ak2, and in order to reproduce gray in Japanese ink Isshiki, it is desirable to be referred to as Ak 1= 1. C*1 is set up in consideration of the gray readout precision in an input signal, and the black thin line in an image is especially determined from C* error when performing conversion to {L*, a*, b*}. C*2 is a parameter for restricting the activity of Japanese ink, and is determined in consideration of saturation distribution of the memory color which makes body warmth representation. Japanese ink is used for the rendering of body warmth, and this prevents that a granular feeling occurs. Therefore, as for Ak2, it is desirable to be referred to as Ak 2= 0. As a parameter default in such a viewpoint to this example C*1=10 Ak 1= 1 C*2=30 Ak 2= 0 (2)
It set up. Thus, since the UCR adjustment parameter in this example is determined only at 2 sets of coordinate points, it can be adjusted simple only by adjusting the coordinate point independently in the range of 0 <=Ak<=1 and 0 <=C*. Generally, it is concentration. / Adjustment devices, such as color adjustment and sharpness adjustment, are interlocked with, and it is used and is effective for texture adjustment of the rendering image according to the class of manuscript especially.
[0030] Two kinds of methods can be considered as a function type. The 1st method is the function type of a broken line mold as shown in drawing 3 . At this time, an adjustment parameter (C*1, Ak1), and (C*2, Ak2) are used, and it is the rate alpha of UCR. At the time of C*<C*1 alpha=Ak 1 At the time of C*1 <=C*<C*2 alpha=(C*-C*1)/(C*2-C*1) x(Ak2-Ak1)+Ak1 At the time of C*2 <=C* Alpha=Ak 2 (3)
It becomes. The 2nd method is a method using the continuous function of monotone and a saturation mold, as the continuous line of drawing 4 shows. this time -- an adjustment parameter (C*1, Ak1), and (C*2, Ak2) -- using -- rate alpha of UCR It is here. alpha=Ak2+(Ak1-Ak2) x [1-tanh (pi/2x(C*-a)/b)]/2 -- a= (C*1+C*2) / 2 b= (C*2-C*1)/2 It is alpha= 1 at the time of alpha> 1. It is alpha= 0 at the time of alpha< 0. (4)
It becomes. Generally, it is dependent on the configuration of the nonlinear conversion circuit 7 of degree process which function type is desirable. The 1st method has turned to the color conversion circuit usually called a direct look-up table method. It is because a direct look-up table method is broken line approximation type conversion in a color space which holds the conversion output in a table format beforehand about the representation point in a color space, and will determine an output value by the linear interpolation operation of a representation point to an arbitration input soon. The 2nd method has turned to the nonlinear conversion circuit 7 of this invention mentioned later. It is more desirable to define by the form where it is because it is expressed by the combination of the sensing element which the nonlinear conversion circuit mentioned later is continuation, and has a differential continuity, and the rate of UCR is also continuation in that case, and it has a differential continuity. Although the formula (4) was used as a rate function operation means 6 of UCR in this example since it was above, this invention is not necessarily restrained by this function type, and the function type of arbitration is applicable.
[0031] {L*, a*, b*} signal outputted from the rate alpha of UCR outputted from the rate function operation means 6 of UCR expressed with a formula (4) and the nonlinear conversion circuit 4 is

inputted into the nonlinear conversion circuit 7, and is changed into the output chrominance signal of cyanogen, a magenta, yellow, and black 4 color. In that case, this conversion is conversion of 4 input -4 output, and is changed into a meaning. It is changed into 4 color output signal of a recording system while the image input signal with which various color definitions differ saves the colorimetry-rendering according to the above process. Moreover, a Japanese ink signal is controlled by this process to raise the quality of an output image most.

[0032] Below, the configuration of the nonlinear conversion circuits 4 and 7 used for the example of this invention is described in more detail. Since the nonlinear conversion circuits 4 and 7 can take the same configuration fundamentally, although treated as the same thing, by explanation, this invention is not limited to it. In addition, the nonlinear conversion circuit illustrated here is based on the technique which these people indicated in Japanese Patent Application No. No. 85157 [five to] "a nonlinear arithmetic unit and the information processor by it" which applied separately previously. The nonlinear conversion circuits 4 and 7 combine two or more nonlinear arithmetic units of each other shown in drawing 5 , and are constituted. A nonlinear operation means for the nonlinear arithmetic unit shown in drawing 5 to have one or more inputs, and to calculate a nonlinear function (g (uj)) to each of that input (uj) (51a-51n), It has the multiplication means 52a-52n which multiply by the weight value (wji), respectively, and an addition means 53 to ask for the sum of the result obtained by that each means of multiplication, and to add a threshold further, to each function value obtained as a result of the operation of those nonlinear operation means. In addition, the adder unit for it may be omitted, using a threshold (iotai) as 0. At this time, it is the output of a nonlinear arithmetic unit (ui). (5) Ui=sigmaj {wji-g (uj)} +iotai
It is come out and expressed. Usually, in the neuron network theory, the output xi of each nerve i receives the inner potential ui of Nerve i. xi=g (ui) (6)
Come out, it is and wji and threshold iotai of a nerve cell i are used for the inner potential ui of Nerve i in the strength of association to Nerve i from the output xj of Nerve j, and Nerve j. Ui=sigmaj {wji-xj} +iotai (7)
It is come out and expressed. Therefore, the circuitry which simulates the cell of the conventional neuron network calculates a formula (6) and a formula (7), gives nonlinear operation g (ui) to the multiplication section of Input xj and the weight value wji, the adder unit which asks for total of a multiplication result, and an adder unit output, and obtains an output. Two or more nonlinear conversion circuits 4 and 7 of this example perform actuation equivalent to actuation of the whole neuron network, when it joins together mutually and constitutes as a network, while the nonlinear arithmetic unit itself differs from the circuitry which simulates the cell of the conventional neuron network. Although the configuration of the nonlinear arithmetic unit of such this invention can realize a digital circuit and an analog circuit, when realizing especially in an analog circuit, a circuit is simplified compared with the circuitry which simulates the cell of the conventional neuron network, the error resulting from a temperature change or a circuit is improved further, and it has the advantage that processing is further accelerable. Therefore, this example describes the case where a nonlinear arithmetic unit is realized in an analog circuit.

[0033] Hereafter, the case where the nonlinear arithmetic unit in the nonlinear conversion circuits 4 and 7 of this example is realized in an analog bipolar transistor circuit is explained in full detail. The analog circuit in that case is constituted by the differential amplifying circuit by one pair of bipolar transistors which combined the 1st terminal (emitter) of each other. By supplying the electrical-potential-difference difference proportional to an input between the 2nd terminal (base) of the 1 to 3 terminal amplifier which constitutes each differential amplifying circuit, and supplying the current which is proportional to the 1st terminal (emitter) suitably at the weight value for multiplication It is the thing of a configuration of obtaining an output as a current difference of a circuit between the 3rd terminal (collector).

[0034] As an example, the case where a bipolar transistor is used is shown in drawing 6 . Difference IC1-IC2 of the collector current IC1 and IC2 of each transistor IC1-IC2=IE-tanh {(VB1-VB2) /2VT} (8)

It is come out and expressed. That is, this circuit gave the ROJISU tic function tanh to input voltage difference VB1-VB2, and has obtained output current difference IC1-IC2 proportional to the value

h g cg b eb cg e e

which multiplied that function value by the weight value IE. This property gives a nonlinear function to each above-mentioned input, and has the function which carries out multiplication to a suitable weight value.
[0035] When taking the sign of positive/negative into consideration, the configuration of a nonlinear arithmetic unit becomes like drawing 7 considering drawing 6 as a basic component. The component 1 of an element -1 and the 1st terminal (emitter) of 3 terminal amplifier of a component 2 are combined, the component 1 of an element -2 and the 1st terminal (emitter) of 3 terminal amplifier of a component 2 are combined, and a differential amplifying circuit (an element -1, element -2) is formed. Next, the 2nd terminal (base) of 3 terminal amplifier of the component 1 of an element -1 and the component 2 of an element -2 is combined, and it considers as an input VIN1. Moreover, the 2nd terminal (base) of 3 terminal amplifier of the component 2 of an element -1 and the component 1 of an element -2 is combined, and it considers as an input VIN2. Furthermore, the 3rd terminal (collector) of 3 terminal amplifier of the component 1 of an element -1 and the component 1 of an element -2 is connected, the 3rd terminal (collector) of 3 terminal amplifier of the 1st output terminal IOUT1, the component 2 of an element -1, and the component 2 of an element -2 is connected, and it considers as the 2nd output terminal IOUT2. By the above, by supplying current difference IE1-IE2 proportional to the electrical potential differences VIN1 and VIN2 proportional to an input, and a weight value, a monotonous function can be given to an input on an owner community, and output current difference IOUT1-IOUT2 proportional to multiplication with which value of positive/negative can be obtained. Output current difference IOUT1-IOUT2 is in that case. IOUT1-IOUT2= (IE1-IE2) and tanh {(VIN1-VIN2) /2VT} (9)
It is come out and expressed.
[0036] as mentioned above, amplifiers with a nonlinear characteristic of three or more terminals, such as a field-effect transistor which generally operates as a balanced modulator although the circuitry by the bipolar transistor explained the example of a configuration of the nonlinear arithmetic unit in the nonlinear conversion circuits 4 and 7 of this invention, the electron tube with a remote cut-off property, and the electron tube with a variable mu factor property, -- monotonous -- an owner -- the property containing a **** function and **** multiplication is acquired.
[0037] The above and a nonlinear arithmetic unit are arranged in the shape of a network, and drawing 8 and drawing 9 show the example of the central converter of the nonlinear conversion circuits 4 and 7. The input of this network is the signal which carried out D / A conversion of the color picture signal transmitted from a workstation etc. in the case of the nonlinear conversion circuit 4. moreover -- nonlinear -- a conversion circuit -- seven -- a case -- UCR -- a rate -- a function -- an operation -- a means -- six -- from -- outputting -- having -- UCR -- a rate -- alpha -- {-- L -- * -- a -- * -- b -- * --} -- a signal -- D / A conversion -- having carried out -- a signal -- it is . In the case of the nonlinear conversion circuit 4, an output is {L*, a*, b*} signal, and the one remaining output serves as a dummy signal. The output signal in the case of the nonlinear conversion circuit 7 is an analog chrominance signal of cyanogen, a magenta, yellow, and black 4 color. A network configuration is interlayer two-layer and the numbers of intermediate cells are four each class. Drawing 8 shows the configuration and an element 82 shows connection between each unit for the nonlinear arithmetic unit which explained the element 81 by drawing 7 . An element 91 expresses the nonlinear arithmetic unit explained by drawing 7 , drawing 9 is the example of the circuit which realizes drawing 8 , and an element 93 is [elements 92 are the current difference / electrical-potential-difference conversion circuit shown in drawing 10 , and] a threshold circuit shown in drawing 11 . By optimizing by the approach of mentioning the weight value and threshold of a nonlinear arithmetic unit later beforehand, this network can perform the input output conversion of a request [**** / on the whole / nonlinear].
[0038] Under the present circumstances, it can realize two or more juxtaposition output processing by small-scale circuitry while it can be processed at a high speed, since the central converter of the nonlinear conversion circuits 4 and 7 of this invention consists of association of the above simple nonlinear arithmetic units. Moreover, compared with the conventional matrix type color conversion method, conversion precision improves by leaps and bounds in respect of the degree of freedom of a

parameter. Moreover, while circuitry is simple as compared with broken line approximation type conversion in a color space which is called a direct look-up table method and which holds the conversion output in a table format beforehand about the representation point in a color space, and will determine an output value by the linear interpolation operation of a representation point to an arbitration input soon, the point that a continuity and a differential continuity are guaranteed to an input output conversion is excellent.

[0039] The nonlinear conversion circuit 4 and the 7 whole are respectively constituted like drawing 12 and drawing 13 considering such the input-output-conversion section as a central converter of the nonlinear conversion circuits 4 and 7. Centering on the nonlinear networks 122 and 132 (drawing 8) mentioned above, the nonlinear conversion circuits 4 and 7 equip the preceding paragraph with the A/D-conversion-nonlinear range converters 123 and 133 in the D/A conversion-nonlinear range converters 121 and 132 and the latter part of those, output {L*, a*, b*} signal and supply 4 color record signals over a recording device by the nonlinear conversion circuit 7 at the nonlinear conversion circuit 4. However, when a recording device is equipped with analog Pulse-Density-Modulation means, such as laser, it is necessarily unnecessary, and the latter A/D-conversion-nonlinear range converter 133 can also be omitted.

[0040] Next, the setting-out approach of of the weight value and threshold of the nonlinear conversion circuits 4 and 7 is described. The same means can be fundamentally used for the setting-out approach of a weight value in the nonlinear conversion circuit 4, and the approach in the nonlinear conversion circuit 7. Generally as an optimization means, the back-propagation method known for the neuron network theory can use. what gave the output of the request to an input as an educator signal, and carried out function conversion of the difference of a actual output and an educator signal beforehand in the back-propagation method -- energy -- carrying out -- a predetermined output set -- setting -- energy -- decreasing -- energy -- 0 -- or a change of a weight value and a threshold is made until it is saturated. This energy serves as a function of each weight value and a threshold, and since the whole of each process of that conversion process is constituted by a function and multiplication, and addition, it can differentiate an energy function by making each weight value and a threshold into a variable. [****] An energy function can be decreased by changing each weight value and a threshold using this differential function, so that an energy function may decrease.

[0041] Using the above technique, the weight value and the threshold setting-out approach for the conversion to CMYK from {L*, a*, b*} in the nonlinear conversion circuit 7 are explained, and the weight value and the threshold setting-out approach of the input color vs {L*, a*, b*} conversion in the nonlinear conversion circuit 4 are described below. Hereafter, the procedure of optimization by the nonlinear conversion circuit 7 in this example is described, referring to drawing 14 .

Step.1 The conversion pair of C, M, Y, K, and L*a*b* is created. Known 4 color record chrominance signal (C, M, Y, K) is supplied to the target recording device, a color-print sample is obtained actually, a response with L*a*b* is a known thing among the input units in a commercial colorimeter or this invention, a colorimetry is carried out, and a L*a*b* signal is acquired. N group (for example, 4 sets of N=P) is created in the form where the nonlinearity of a recording device was taken into consideration for this pair.

Step.2 He is CIE about an energy function in conversion of C, M, Y, and K->L*a*b*. L*a*b* It learns as deltaE. C, M, Y, and K are learned with a back-propagation method by making an input and a L*a*b* colorimetry value into an output educator signal among the conversion pairs of N group obtained by Step.1. Under the present circumstances, as energy function E, he is CIE. L*a*b* deltaE is used.

E=sigma {(L*-L*') 2+(a*-a*') 2+(b* -b*') 2} 1/2 (10)

It is alike and a definition is given more. here -- L*', a*', and b* -- ' -- a prediction output value -- that is, it is nonlinear.

Step.3 L*a*b*->Kmax is learned using the subset of a conversion pair of C, M, Y, K, and L*a*b*. Among the conversion pairs of C, M, Y and K which were obtained by Step.1, and L*a*b*, at least one of C, M, and the Y extracts only what is 0, and it considers as a subset. In the subset, L*a*b* is made as an input and it learns with a back-propagation method by making K signal into an output educator

h g cg b eb cg e e

signal. Since all K signals in this subset are the signals when reappearing at 100% of rates of UCR, this conversion will obtain the maximum Kmax of K signal which can be set up, saving the given L*a*b* signal in colorimetry. Under the present circumstances, as energy function E, when Kmax' is made into a prediction output value, it is E=sigma {(K-Kmax') 2} 1/2. (11)
Or it asks for C, M, Y, Kmax->L*a*b*, and C, M, Y, and Kmax'->L*a*b*' by Step.2, and is the distance on color difference space. E=sigma {L*-L*'2+(a*-a*')2+(b*-b*') 2} 1/2 (12)
It is alike and a definition is given more.
Step.4 The rate alpha of UCR is computed based on Kmax of Step.3, and K of a conversion pair of Step.1, and it is L*a*b*alpha. -> C, M, Y, and K conversion are learned. Kmax is obtained to L*a*b* using the conversion first obtained by Step.3. On the other hand, K signal of C, M, Y, and K which are the conversion pair of L*a*b* is referred to, and it is alpha=K/Kmax about the rate alpha of UCR. (13)
It comes out and computes. By applying this actuation to all the conversion pairs of N group of Step.1, it is newly L*a*b*alpha. C, M, Y, and K conversion pair are formed.
Step.5 L*a*b*alpha->C, M and Y, and K conversion pair are learned, and the weight value and threshold which are acquired as a result are set as the optimum value of the nonlinear conversion circuit 7. under the present circumstances -- an energy function -- E -- ****** -- C -- ' -- M -- ' -- Y -- ' -- K -- ' -- prediction -- an output value -- ** -- carrying out -- if -- E=sigma {(C-C') 2+(M-M') 2+(Y-Y') 2+(K-K') 2} 1/2 (11)
or the conversion obtained by Step.2 -- C, M, Y, Kmax->L*a*b*, and C, M, Y and Kmax'->L* -- 'a*'b*' -- asking -- distance on color difference space E=sigma {L*-L*'2+(a*-a*')2+(b*-b*')2} 1/2 (12)
It is alike and a definition is given more. L*a*b*alpha is made as an input and it learns with a back-propagation method by making C, M, Y, and K into an output educator signal. When an energy function is made into a formula (12), the optimal weight value and optimal threshold which minimum-ize energy function E of a formula (10) are set as the optimum value of the nonlinear conversion circuit 7. Moreover, it is also possible to approximate the latter from (11) similarly.
[0042] By passing through the above process, the weight value and threshold of the nonlinear conversion circuit 7 are determined, and a L*a*b* signal is changed into a desired record chrominance signal with the configuration of this invention shown in drawing 1 . It is dependent on the stability of a recording device etc. how this optimization process is performed. If the recording device is dramatically stable, the above-mentioned process is good only by memorizing the weight value and threshold which carried out experimentally to the last and were acquired there as a value of a proper. When a recording device is unstable, a part thru/or all of a learning function more than can also be incorporated as a function of the color reproducing unit which builds in the color picture art of this invention. For example, known 4 color record chrominance signal (C, M, Y, K) is stored in the memory in equipment in the specific mode of equipment, the test print of them is carried out in the specific mode of equipment, it is read by the output color detecting element in a color recording device, and a L*a*b* signal is acquired. Hereafter, actuation to Step.5 is performed by the software in equipment, and it re-stores in predetermined memory. Thus, if constituted, it is also possible to offer the color-print which compensated the property fluctuation by the environment of a recording device etc. with required timing, and was always stabilized.
[0043] Next, the optimization approach of of the weight value and threshold of the nonlinear conversion circuit 4 is described. In the nonlinear conversion circuit 4, the weight value and threshold of the input color vs {L*, a*, b*} conversion of arbitration are set up in the weight memory 3. The setting-out gestalt is divided into two kinds such as the case where a color-data class (Dflg) is known, and the case of being strange. What is necessary is to set up only the result of having enforced the optimization approach of a weight value and a threshold off-line, and having performed processing based on the back-propagation method mentioned above, in the weight memory 3, when a color-data class (Dflg) is known. In this case, a result is obtained by performing off-line the procedure shown in drawing 15 . For example, the printing standard color sample of 1000 **** is defined by the color input (called DIC qualification) whose color space color matching with the application of drawing 2 is CMYK in DIC. Therefore, if they are beforehand learned as educator data and the study result is set up in the weight memory 3, it can

respond. Next, the case where a color-data class (Dflg) is strange is described. In this case, reference data (Tdat) are performed in the study circuit 2, and optimization of a weight value and a threshold is performed on-line. The procedure is carried out in the same procedure as the case where the color-data class (Dflg) shown in drawing 15 is known. Moreover, a back-propagation method is usable as the optimization approach, and it is also possible to carry out efficiently by other well-known study approaches. Moreover, since count will become complicated if the energy function described previously is differentiated in the process in which it learns actually, it is common to learn so that energy with an educator signal may decrease for every pair of an input signal and an educator signal. Moreover, back propagation In law, an error may not serve as the minimum value but may serve as the minimum value. In the learning process, it is known by adding a proper noise to each weight or a threshold that it is effective for this phenomenon. As mentioned above, although the thing using back propagation study was described, if it is generally a system based on the neuron network theory in which study with an educator is possible, it is possible to use as a nonlinear conversion circuit of this invention.
[0044] in addition, explanation of the above example -- setting -- plurality -- difference -- although the example which changes an input signal into the image recording signal of one output unit was given, modification implementation of the nonlinear conversion circuit 7 can be carried out so that it may correspond to two or more sorts of different output units. That is, the weight memory 9 shown with the broken line of drawing 1 is formed, only the number corresponding to two or more output units to which the information which defines conversion to L*, a*, b*, Yout from alpha, Mout, Cout, and Kout is connected is prepared, and it holds in the weight memory 9. The definition information on conversion that it corresponds with the signal Psel which chooses the output unit of the request from the outside is read from the weight memory 9, and it is set as the nonlinear conversion circuit 7. It becomes possible to choose and output the output unit of the property that plurality differs by this, for example, a printer.
[0045]
[Effect of the Invention] Color transform processing corresponding to the input chrominance signal with which plurality is different from each other becomes possible according to this invention, as explained above, especially with the configuration whose response by self-study the response with color system of coordinates enabled also to the undefined input chrominance signal, various Calah put in practical use in a rear spring supporter and a broad technical field current and in the future and interconnect with - image device are attained, and color reproduction of the request which various color picture devices require can be realized.
[0046] Moreover, in this invention, when it considers as the configuration which performs UCR adjustment also in consideration of the improvement in image quality in consideration of the property of a recording device (the improvement in texture, gray rendering stabilization, granular feeling reduction of a memory color, etc.), it not only guarantees the fidelity of color reproduction, but it demonstrates the effectiveness which raises the quality of an output image itself.
[0047] According to this invention (claims 1-16), moreover, by making 3 variable chrominance signal on the uniform color space [target / perception] like a step intervene A series of the processings of all are constituted by device independent. Since the basis of a rate brightness [target / which matched human being's sensibility / perception] and chromaticity separation signal performs, required adjustment is realized applicable in the form which was well in agreement with human being's sensibility, without depending for this invention on an image recording method.
[0048] Moreover, since this invention is equipped with the nonlinear conversion circuit which consists of association of the above simple nonlinear arithmetic units, while it can be processed at a high speed, juxtaposition output processing of four colors is realizable by small-scale circuitry. Moreover, compared with the conventional matrix type color conversion method, conversion precision improves by leaps and bounds in respect of the degree of freedom of a parameter. Moreover, the conversion output is beforehand held in a table format about the representation point in a color space called a direct look-up table method. While the transform coefficient memory to two or more input chrominance signals is dramatically small as compared with broken line approximation type conversion in a color space which will determine an output value by the linear interpolation operation of a representation point to an

arbitration input soon Since a continuity and a differential continuity are guaranteed to an input output conversion, in case the image with which the gradation of a delicate color like computer graphics is contained is reproduced, the point which does not produce a false profile is excellent.
[0049] Since it is such, the color picture processor concerning this invention is very suitable as an image processing system in wide range fields, such as a printing scanner, a video printer, a digital color copy, and a color proof system.

[Translation done.]

* NOTICES *

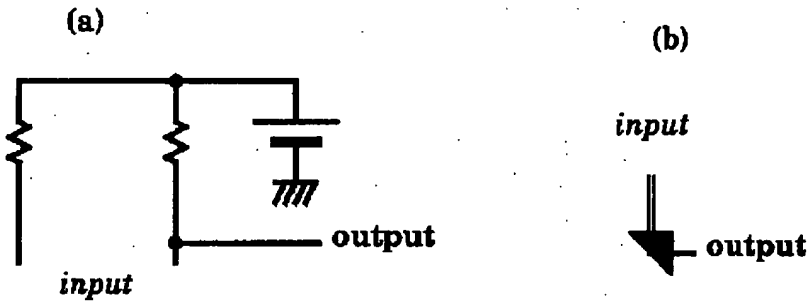
Japan Patent Office is not responsible for any
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

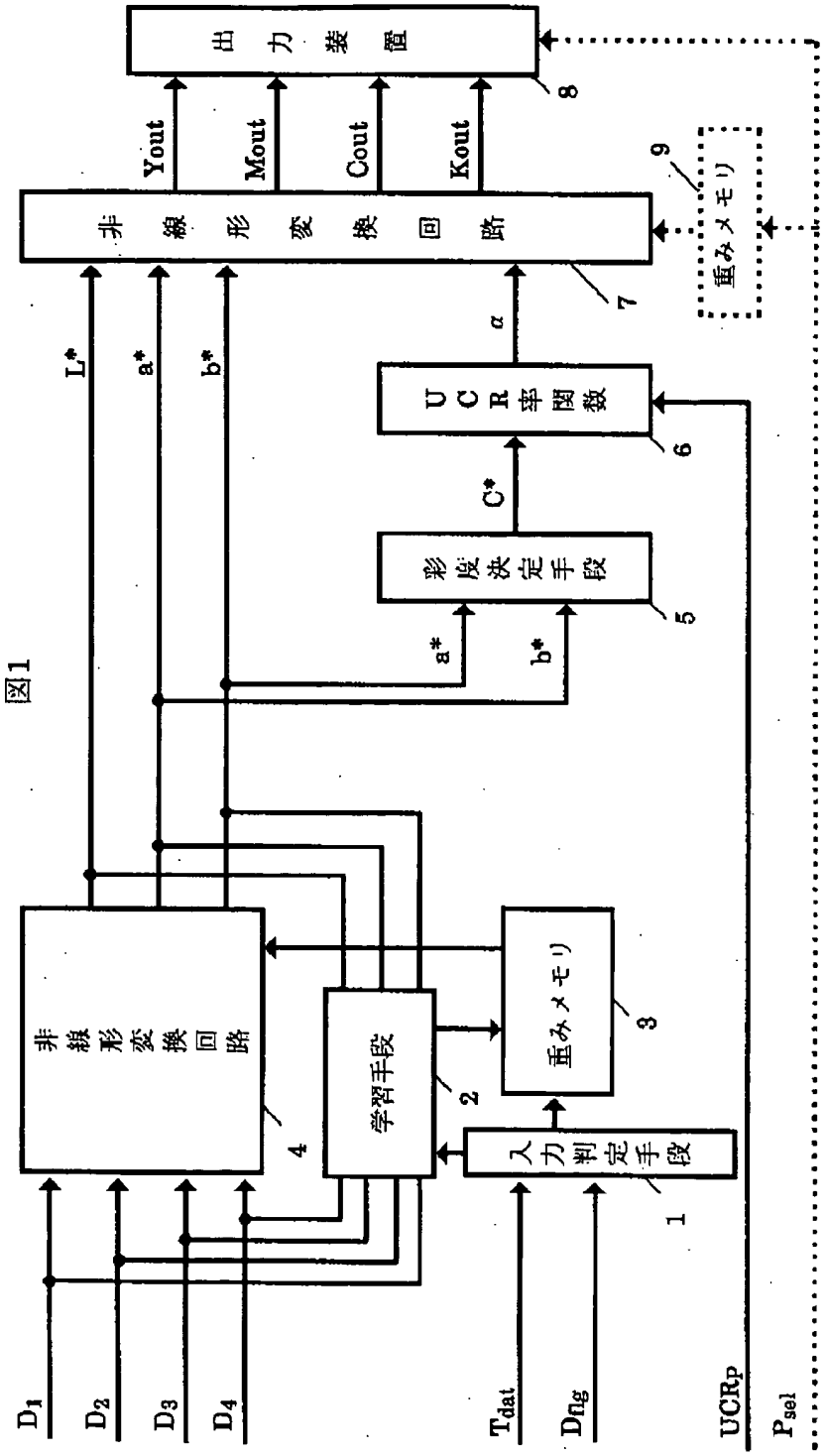
[Drawing 10]

図10



[Drawing 1]

図1



[Drawing 2]

h g cg b eb cg e e

[Drawing 3]

図2

アプリケーション	種類	色空間	カラーマッチング	入力ファイル	出力ファイル	特殊機能
Illustrator 3.2	イラストレーション	CMYK	PANTONE TOYO DIC	EPS (MacDraw/Ⅱ)	EPS	グラフ作成
FreeHand 3.1	イラストレーション	RGB HSL CMY CMYK	PANTONE TOYO DIC	EPS TIFF PICT MacPaint	EPS	自動グラデーション PostScriptプログラムの挿入
PhotoShop 2.01	イメージ編集	Gray RGB CMYK HSL HSB	PANTONE TRUEMATCH FOCOLTONE DIC TOYO	GIF EPS MacPaint PICT PIXAR TIFF	EPS PICT PIXAR TIFF	プラグインによる拡張
PageMaker 3.5J	ページレイアウト	RGB HSL CMYK	PANTONE	MacPaint PICT EPS TIFF		拡大/縮小プリント ミニプリント

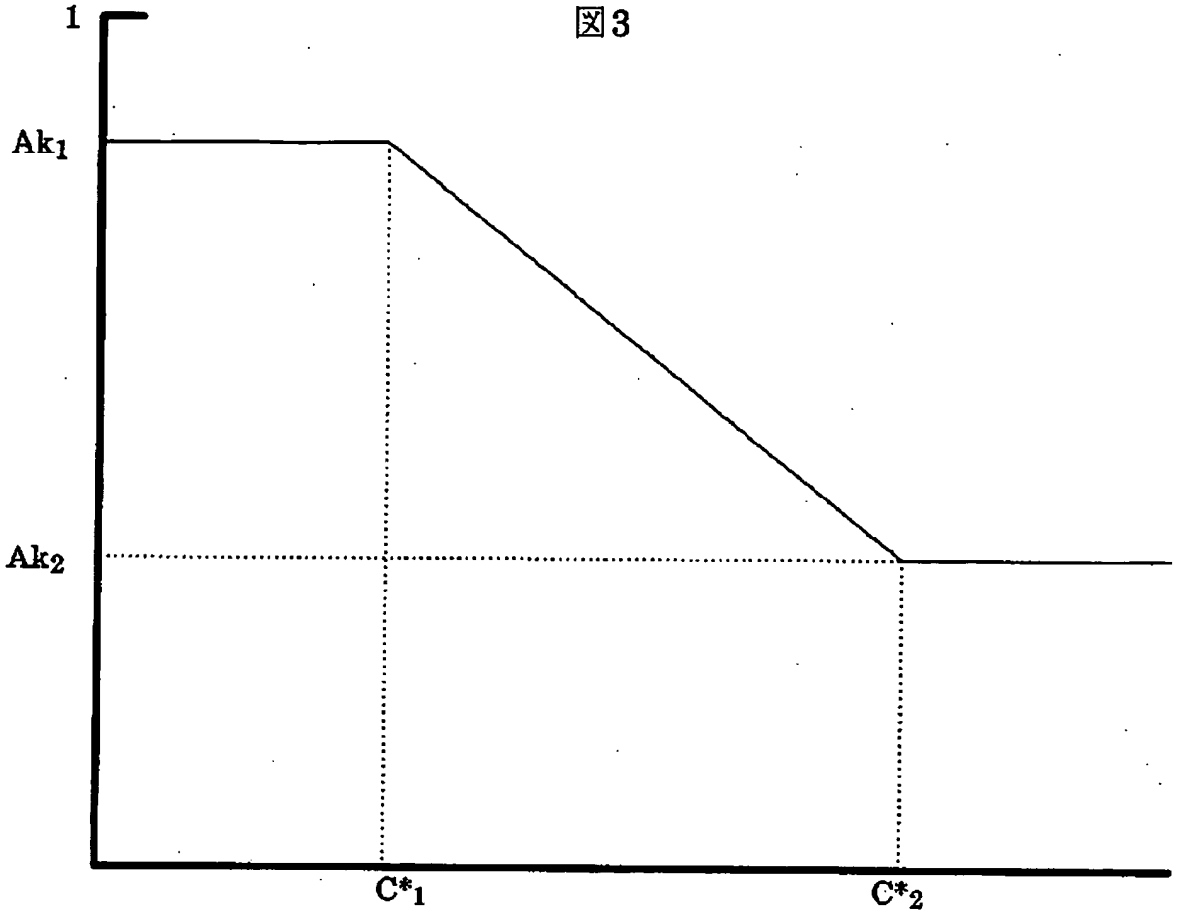


図3

C^* $\{(a^{*2}+b^{*2})^{1/2}\}$

[Drawing 6]

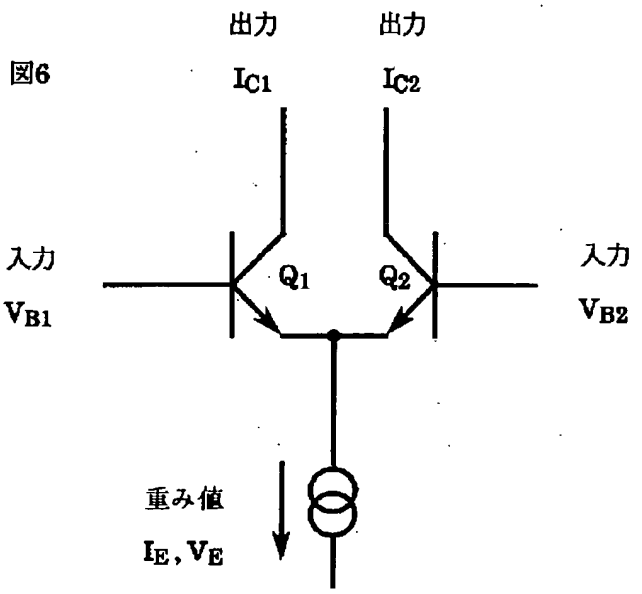
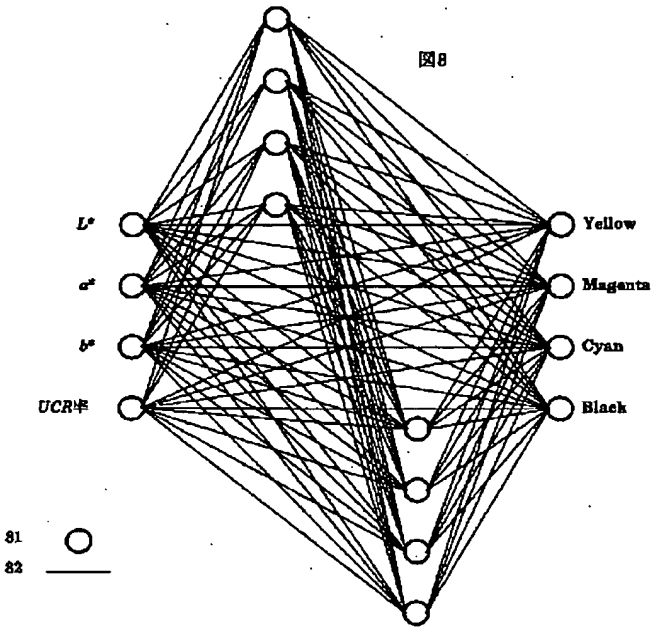


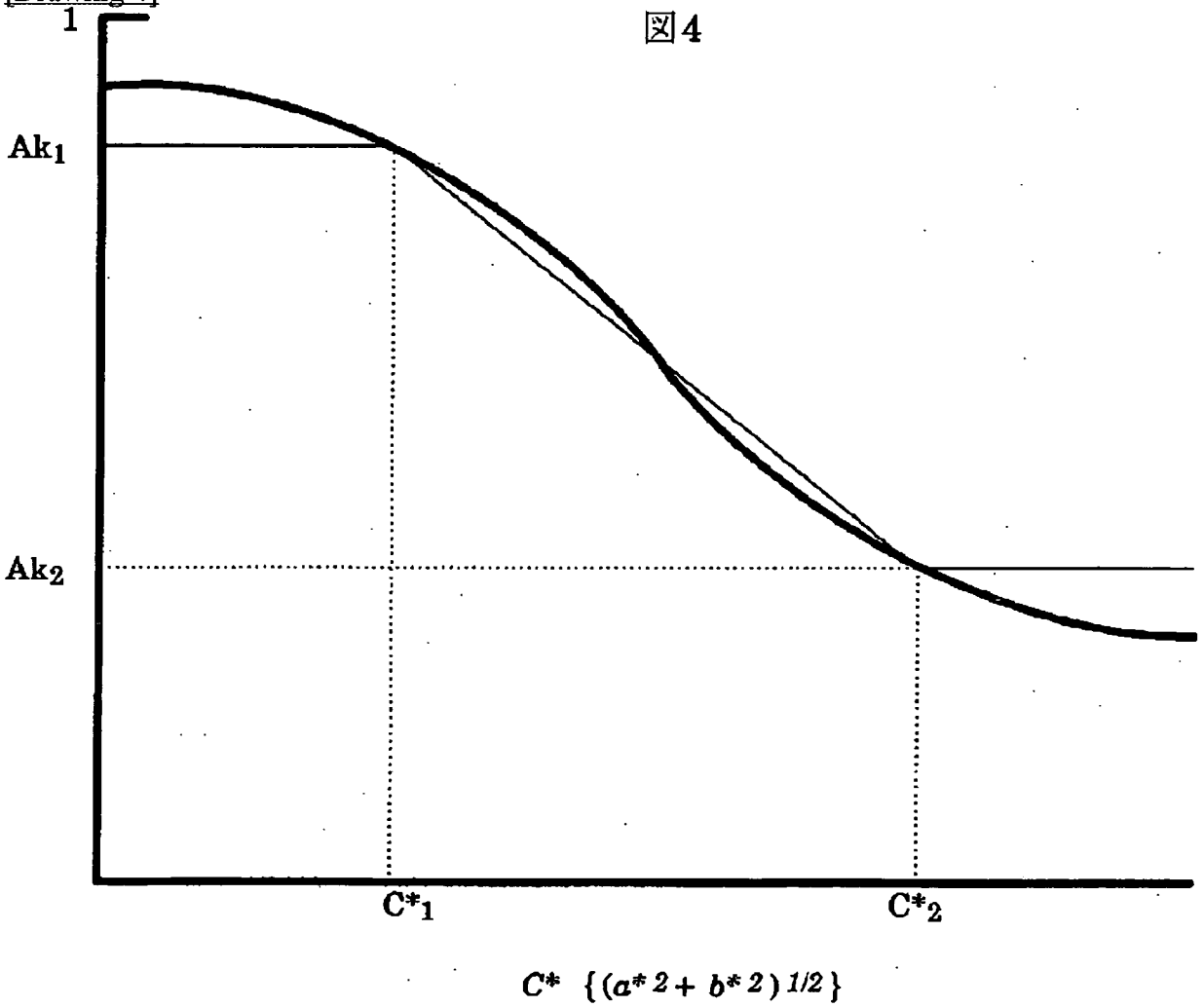
図6

[Drawing 8]

h g cg b eb cg e e



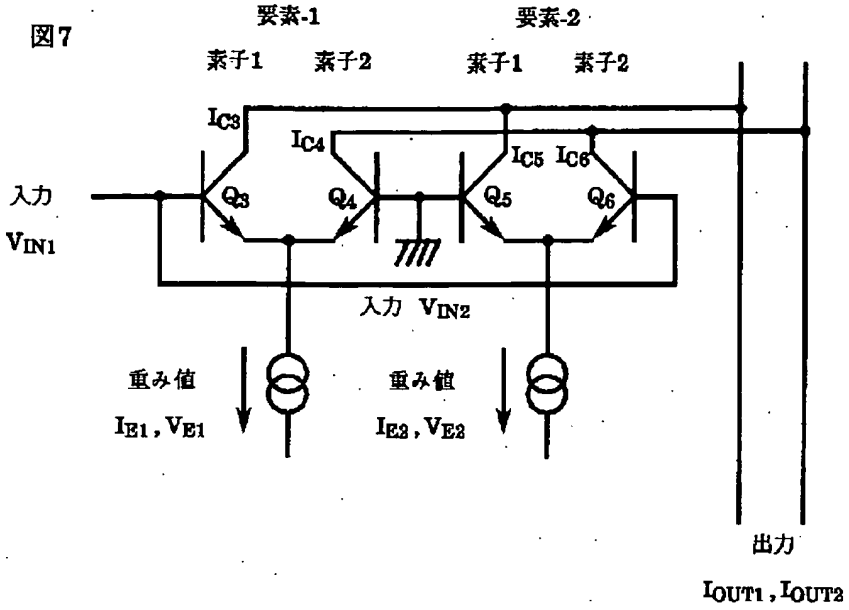
[Drawing 4]



[Drawing 7]

h g cg b eb cg e e

図7



[Drawing 5]

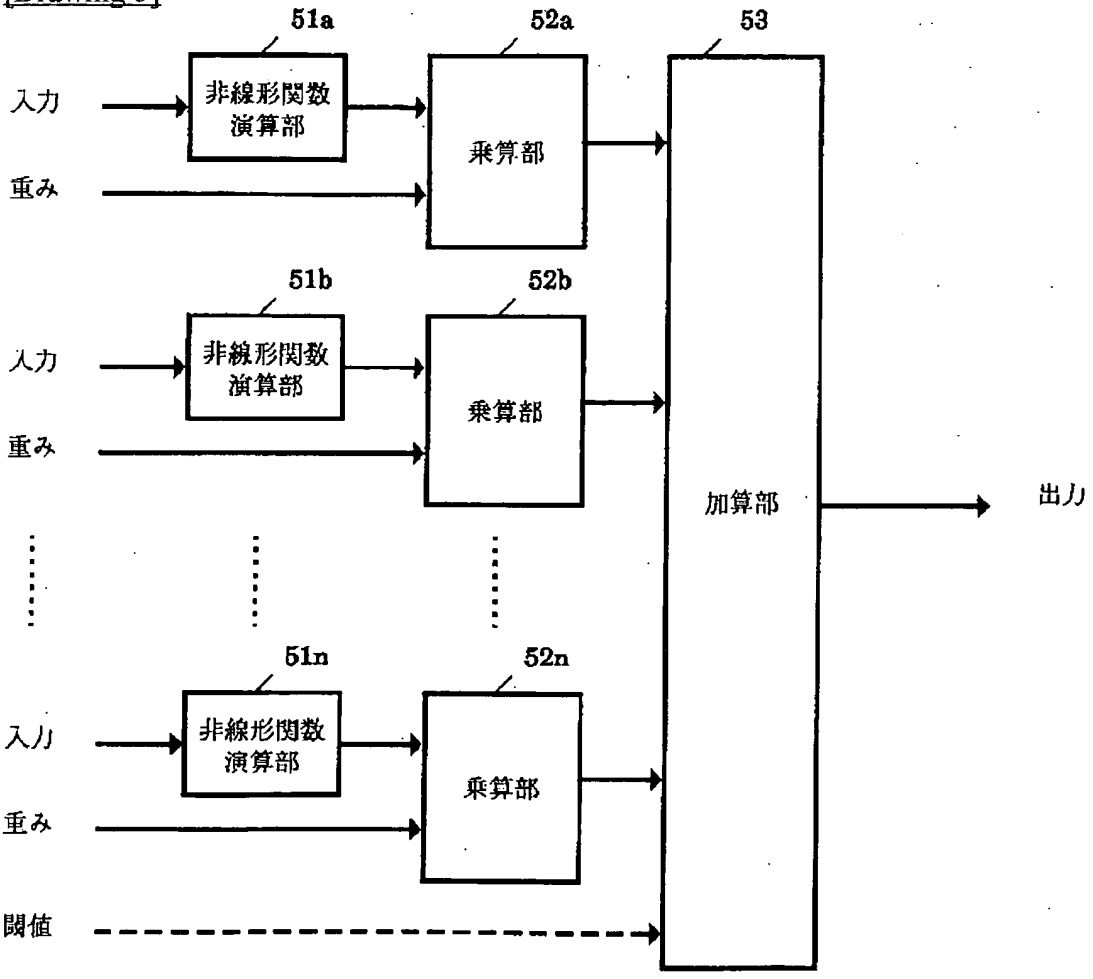


図5

[Drawing 9]

h g cg b eb cg e e

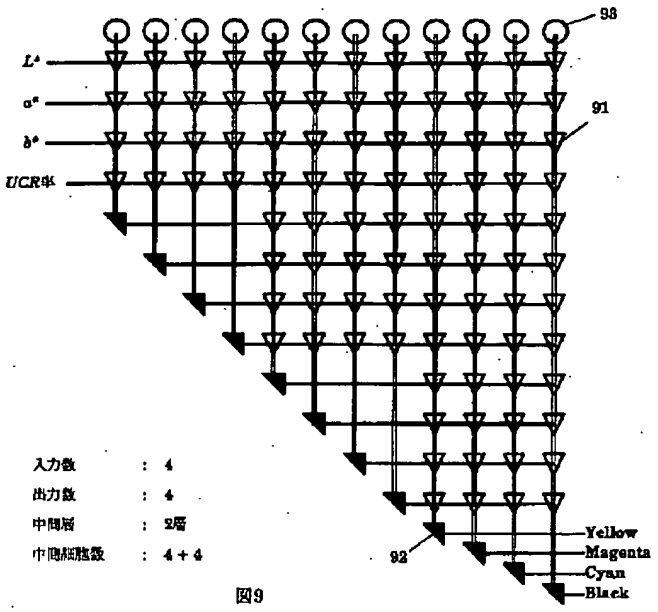
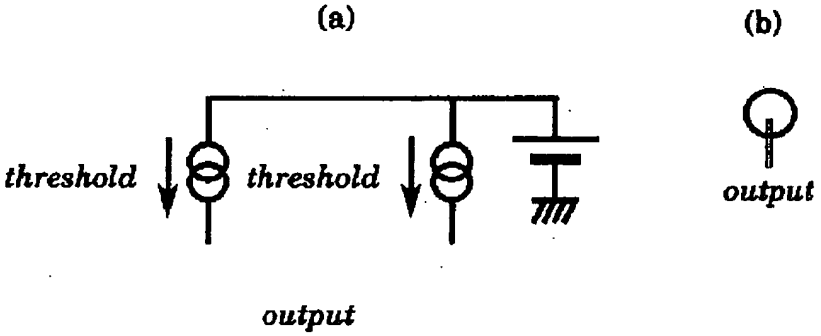


図9

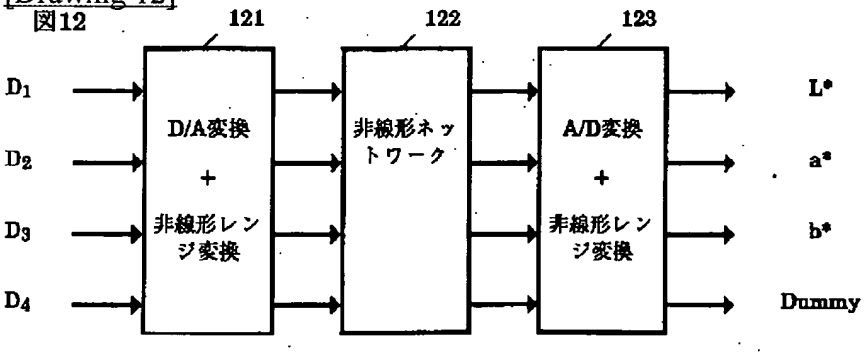
[Drawing 11]

図11



[Drawing 12]

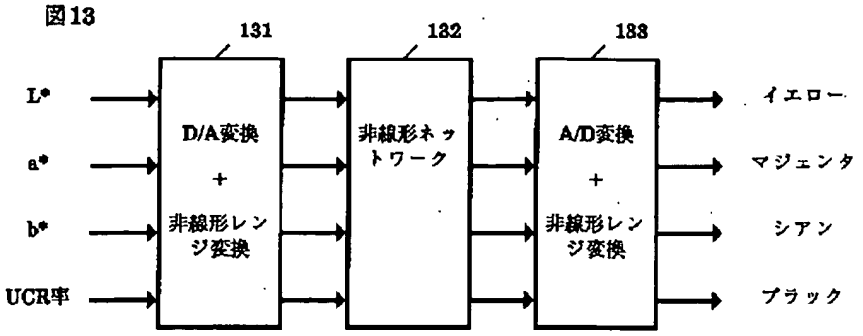
図12



[Drawing 13]

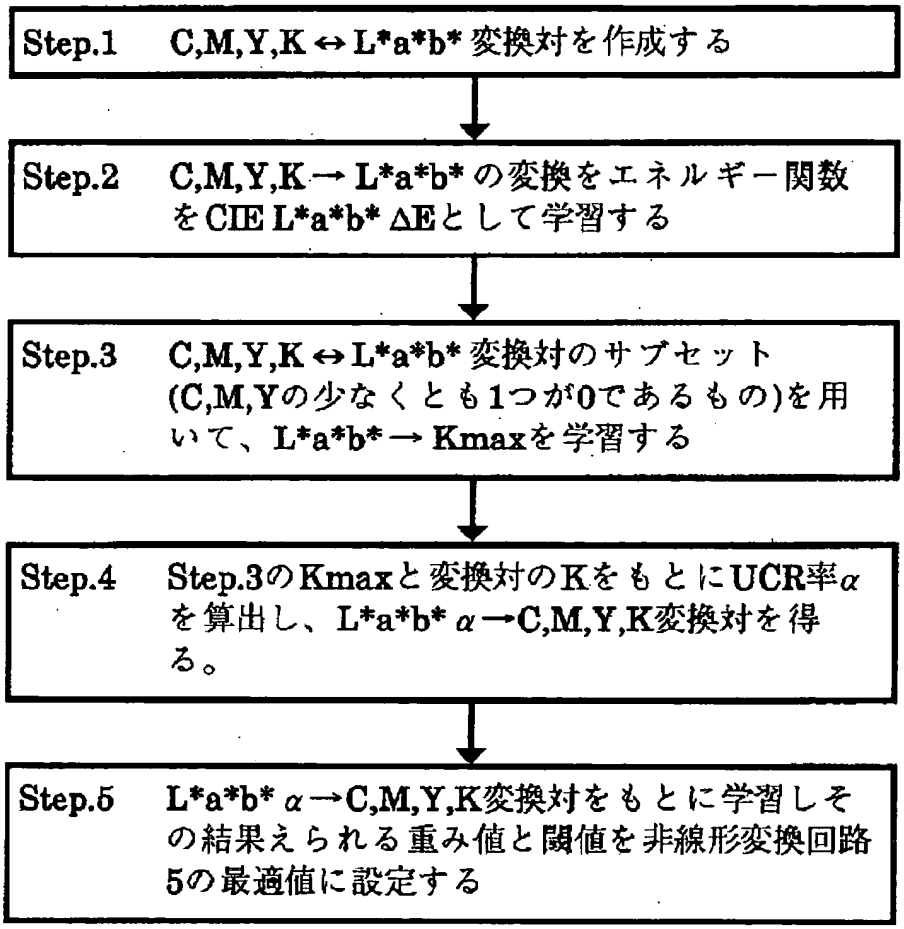
h g cg b eb cg e e

図13



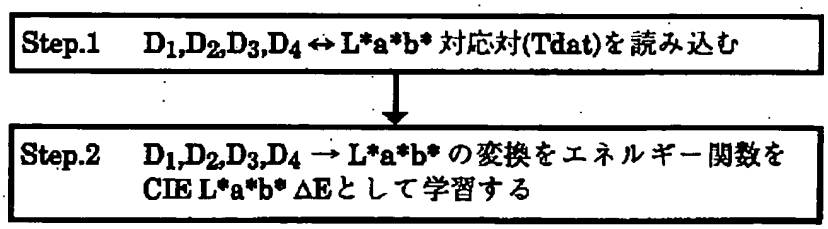
[Drawing 14]

図14



[Drawing 15]

図15



h g cg b eb cg e e

[Translation done.]

h g cg b eb cg e e